Risk factors for SSI after open heart surgery
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Kobe City Medical Center General Hospital

- 768 beds
- Designated as a Core Hospital in the region
- 2000 outpatients/day
- The average length of stay: 10.4 days (FY2017)
- Moved to a new hospital in July 2017

Background
- A cardiovascular surgery is highly invasive by nature. In addition, due to the aging of patients and the advancement of complex procedural techniques, high-risk patients are increasing in number. Therefore it is extremely important to take appropriate Surgical Site Infection (SSI) prevention measures and continuously monitor its occurrence.
- In our hospital, SSI prevention measures have been implemented since 2008 in partnership between Cardiovascular Surgical Service and Department of Infection Control. The hospital moved to a new location in July 2011, which resulted in big changes in the operating room environment. The SSI measures were continued in the new hospital, yet we didn’t investigate causes of SSIs nor monitor completion with the SSI measures.

Objective
- To identify causes of SSI occurrence including compliance with SSI Prevention Bundle in order to prevent SSI after cardiac surgery.

METHOD

Study design: Retrospective cohort study
Inclusion criteria:
- Patients who received cardiac surgery during Period I and Period II
- Period I: from January 2008 to December 2010 (Infection control measures were started)
- Period II: from January 2014 to December 2016 (Infection control measures were reinforced)
Exclusion criteria:
- Patients < 20 years of age
- Patients whose death was confirmed during the follow-up

Operative method:
CARD/CABG/TTA/Complex surgery

Outcomes:
- SSI occurrence
- Case definition by CV surgeons and ICU on the CIC definition
- Including followings;
  - Superficial incisional SSI
  - Deep incisional SSI
  - Organ/Space SSI (mediastinitis, graft infection and others)

Observation items:
- pre-, intra-, post-operative risk factors for SSI
- SSI Bundle:
  1. Prophylactic antibiotic within 1 hour before incision
  2. Appropriate prophylactic antibiotic(Cefazolin or Vancomycin)
  3. Antibiotic discontinuation within 72 hours after surgery
  4. Glucose control on post-operative day 1 morning(<160mg/dl)
  5. No hair removal with clipper
  6. Hair removal with clipper
  7. Normothermia just after surgery (≧36℃)

Analytical method:
- Comparison between Period I and II for adherence to the SSI prevention bundle after descriptive statistics
- Multivariate analysis by multiple logistic regression
- JMIM3 for statistical analysis

Ethics:
- Approved by the hospital Internal Review Board

RESULT

Characteristics of subjects

<table>
<thead>
<tr>
<th>Variables</th>
<th>Subjects (n=1579)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD</td>
<td>68.1±12</td>
</tr>
<tr>
<td>BMI, mean ± SD</td>
<td>23.8±3.6</td>
</tr>
<tr>
<td>Surgical procedure</td>
<td></td>
</tr>
<tr>
<td>TTA/Complex surgery</td>
<td>708/384/218</td>
</tr>
<tr>
<td>ASA score (3), (%)</td>
<td>1240/78</td>
</tr>
<tr>
<td>Smoking, (n%)</td>
<td>792/50 (62)</td>
</tr>
<tr>
<td>Diabetes, (n%)</td>
<td>418/26 (30)</td>
</tr>
<tr>
<td>Glycemia, (n%)</td>
<td>936</td>
</tr>
<tr>
<td>Operative duration, median [IQR]</td>
<td>377/306-455</td>
</tr>
<tr>
<td>Post-operative glucose level Day 1 morning, mean ± SD</td>
<td>144±26</td>
</tr>
<tr>
<td>Post-operative glucose level Day 2 morning, mean ± SD</td>
<td>140±33</td>
</tr>
</tbody>
</table>

Incidence of SSI

- 1.2% (44 cases)
- 2.9% (27 cases)

SSI bundle implementation rate by surgical period

Logistic regression analysis of variables associated with SSI

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age&lt;65 years old</td>
<td>0.78</td>
<td>0.46-1.3</td>
<td>0.27</td>
</tr>
<tr>
<td>Men</td>
<td>1.3</td>
<td>0.72-2.2</td>
<td>0.26</td>
</tr>
<tr>
<td>Pre-operative duration&lt;5 hours</td>
<td>2.2</td>
<td>0.85-5.8</td>
<td>0.14</td>
</tr>
<tr>
<td>Surgical period (Period II)</td>
<td>0.41</td>
<td>0.23-0.70</td>
<td>0.061</td>
</tr>
</tbody>
</table>

Surgical procedure

<table>
<thead>
<tr>
<th>CARB</th>
<th>reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARG</td>
<td>1.1</td>
</tr>
<tr>
<td>TAX</td>
<td>1.5</td>
</tr>
<tr>
<td>Multiple procedures</td>
<td>2.5</td>
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</tbody>
</table>

Surgical Bundle

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABG</td>
<td>0.57</td>
<td>0.33-0.97</td>
<td>0.040</td>
</tr>
<tr>
<td>CXA</td>
<td>1.03</td>
<td>0.56-1.9</td>
<td>0.59</td>
</tr>
<tr>
<td>Surgical period (Period II)</td>
<td>0.77</td>
<td>0.44-1.3</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Operator bundle

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABG</td>
<td>0.74</td>
<td>0.42-1.3</td>
<td>0.30</td>
</tr>
<tr>
<td>CXA</td>
<td>0.6</td>
<td>0.33-1.2</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Surgical bundle adherence

- CABG: 61.9%, CXA: 38.1%

DISCUSSION

Compliance with SSI prevention bundle

To study effectiveness of the SSI prevention measures after the hospital relocation, compliance with the SCIP SSI bundle was evaluated.

- A systematic review on effectiveness of the SSI prevention bundle showed odds ratio of 0.82 when adherence improved.
- In our study, SSI rate significantly decreased in Period II when adherence to Bundle increased. This indicates improved Bundle compliance contributed to reduction in SSI.
- Other factors might be associated to SSI decrease in Period II such as changes in the environment and HCWs, introduction of new infection control measures and differences in patient background.

Administration of prophylactic antibiotic within 1 hour before incision

- A purpose of antibiotic prophylaxis is to prevent SSI. Selection of antibiotic and drug, dose, timing and duration of administration is important.
- Antibiotic needs to reach a therapeutic level of blood and tissue concentration at a start of surgery. A recommended timing of administration is 1 hour before incision.
- Antibiotic should be started 1 hour before incision.
- Compliance with the recommendation was 80% and 20% of cases exceeded 1 hour before incision.

Conclusion

- Multiple procedures in a surgical case carries high risk for SSI in cardiac surgery. Period II which showed better adherence to SSI bundles and a start of prophylactic antibiotic within 1 hour before incision lowered SSI risks.
- The results indicate importance of improved SSI Bundle adherence and administration of prophylaxis within 1 hour before incision.

Consequence

- Multiple procedures in a surgical case carries high risk for SSI in cardiac surgery. Period II which showed better adherence to SSI bundles and a start of prophylactic antibiotic within 1 hour before incision lowered SSI risks.
- Optimization of prophylactic antibiotic timing and preparation of a written procedure in collaboration with a surgical team
- Continuous monitoring and evaluation

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